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Ohta et al.

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(45) **Date of Patent: Oct. 25, 2016**

(54) **IMAGE FORMING APPARATUS**

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(30) **Foreign Application Priority Data**

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(51) **Int. Cl.**
G03G 15/00 (2006.01)

(52) **U.S. Cl.**
CPC ***G03G 15/6552*** (2013.01)

(58) **Field of Classification Search**
CPC G03G 15/6552; G03G 15/6555
See application file for complete search history.

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(57) **ABSTRACT**

An image forming apparatus is provided, including an apparatus body; an image forming unit to form an image on a sheet member; and a sheet ejection container including a sheet ejection tray on which the sheet member ejected from the apparatus body is stacked. In the image forming apparatus, at least one side of the apparatus body is open and the sheet ejection container is disposed inside the apparatus body at the open side. The sheet ejection tray is configured to be movable between a first position in the sheet ejection container where the sheet member is ejected to the sheet member tray and a second position nearer to the open side than the first position.

14 Claims, 11 Drawing Sheets

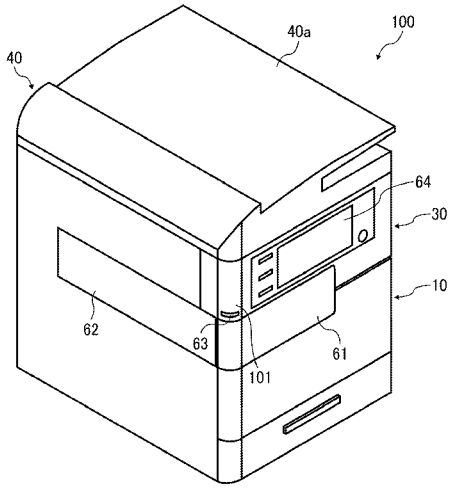

FIG. 1

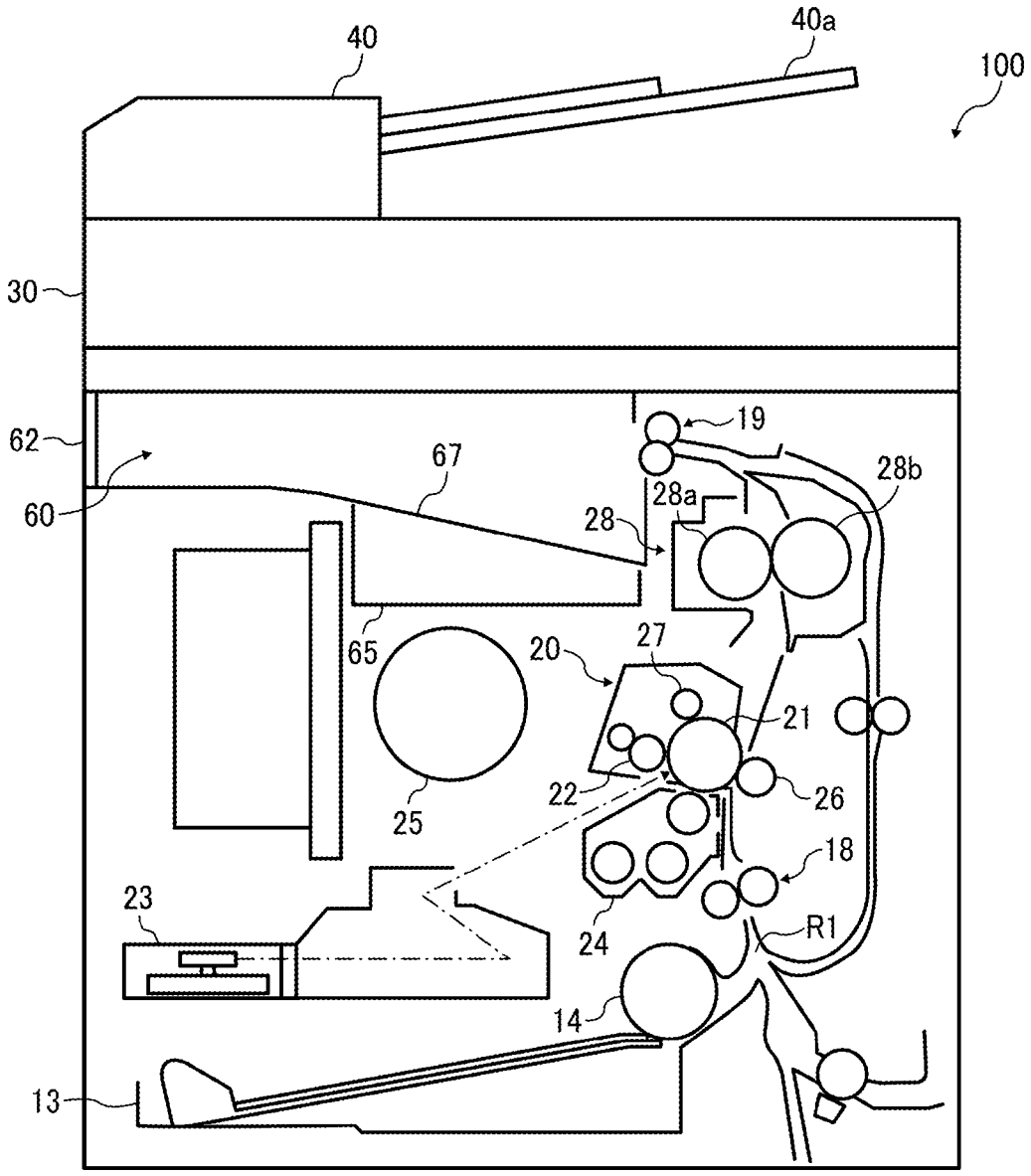
40
40a
100
30
62
60
67
19
28b
28a
28
65
20
27
21
22
26
25
18
23
24
R1
14
13

FIG. 2

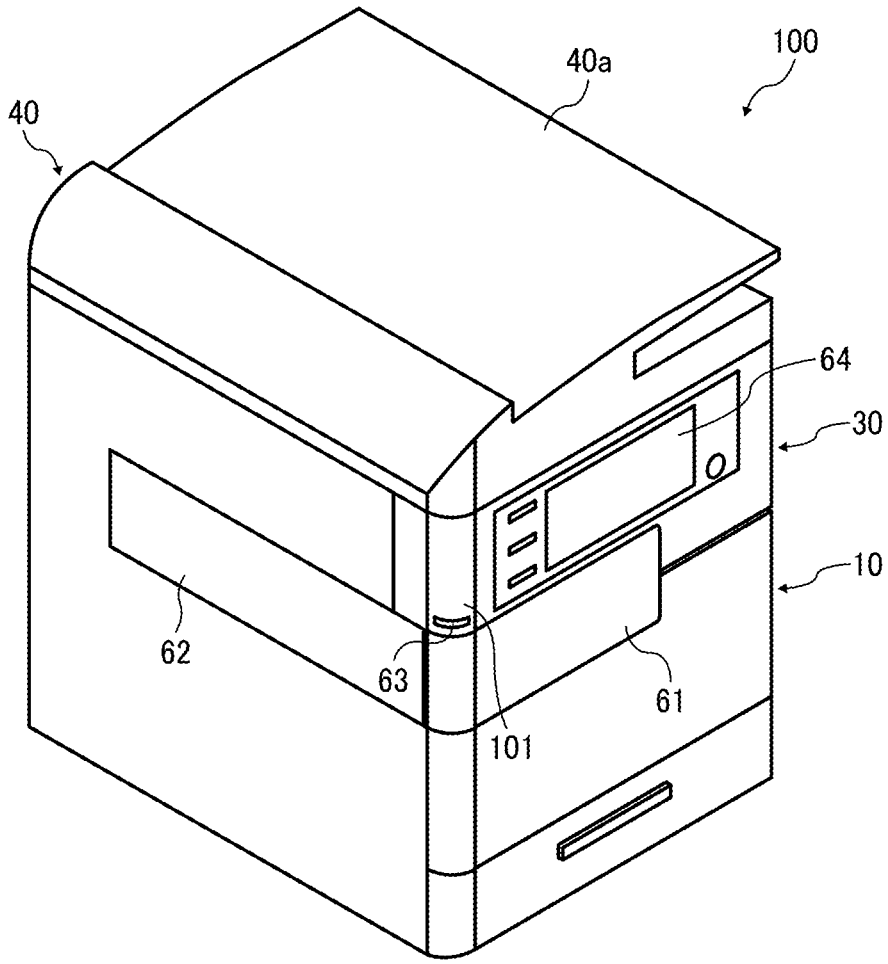

FIG. 3

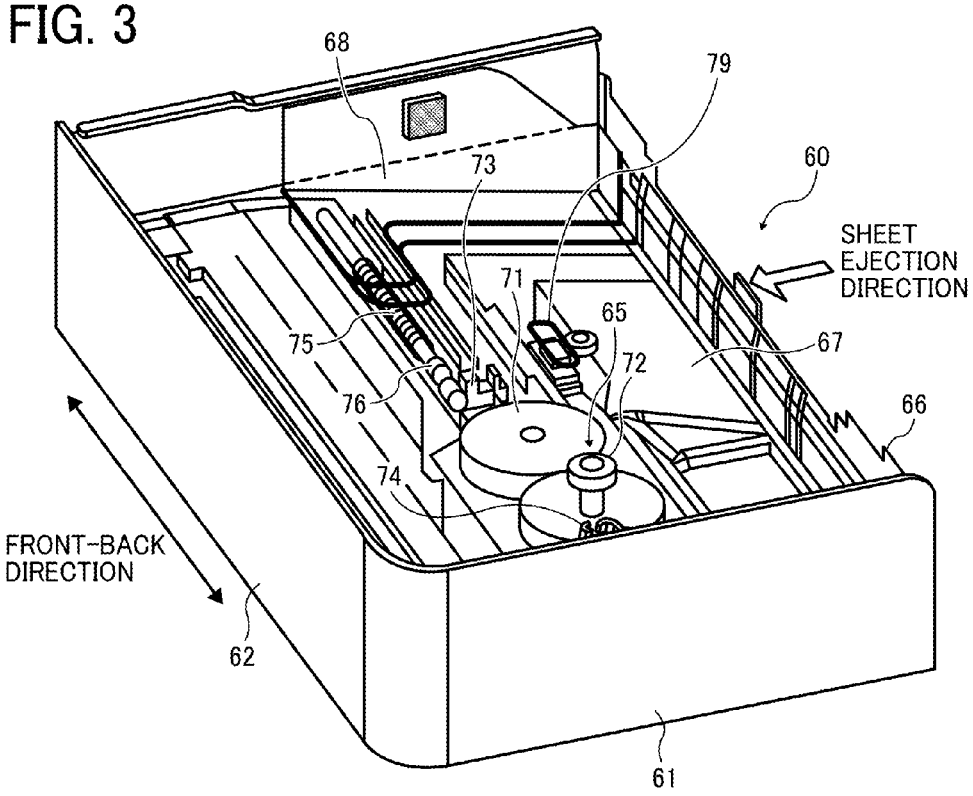
68
79
73
60
SHEET
EJECTION
DIRECTION
71
65
75
67
72
76
66
74
FRONT-BACK
DIRECTION
62
61

FIG. 4

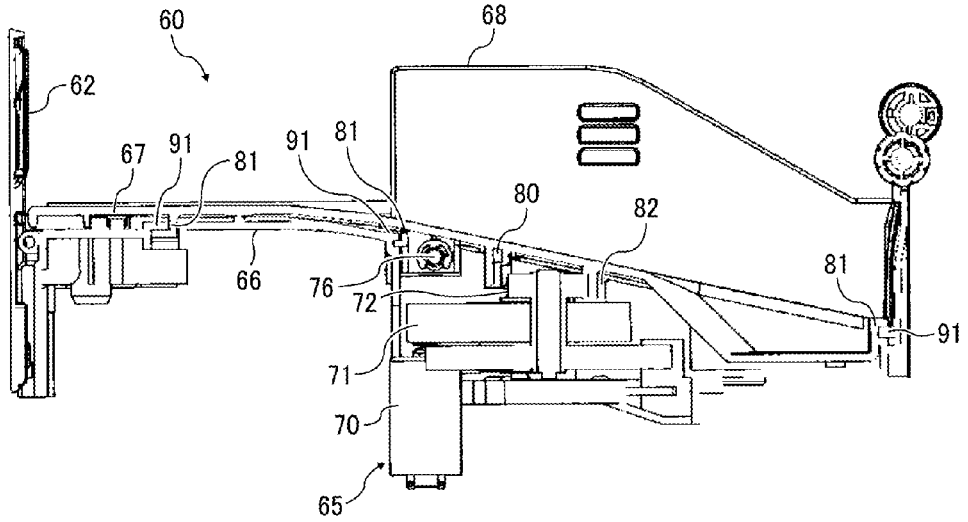
60
68
62
67
91
81
91
81
80
82
66
76
72
81
91
71
70
65

FIG. 5A

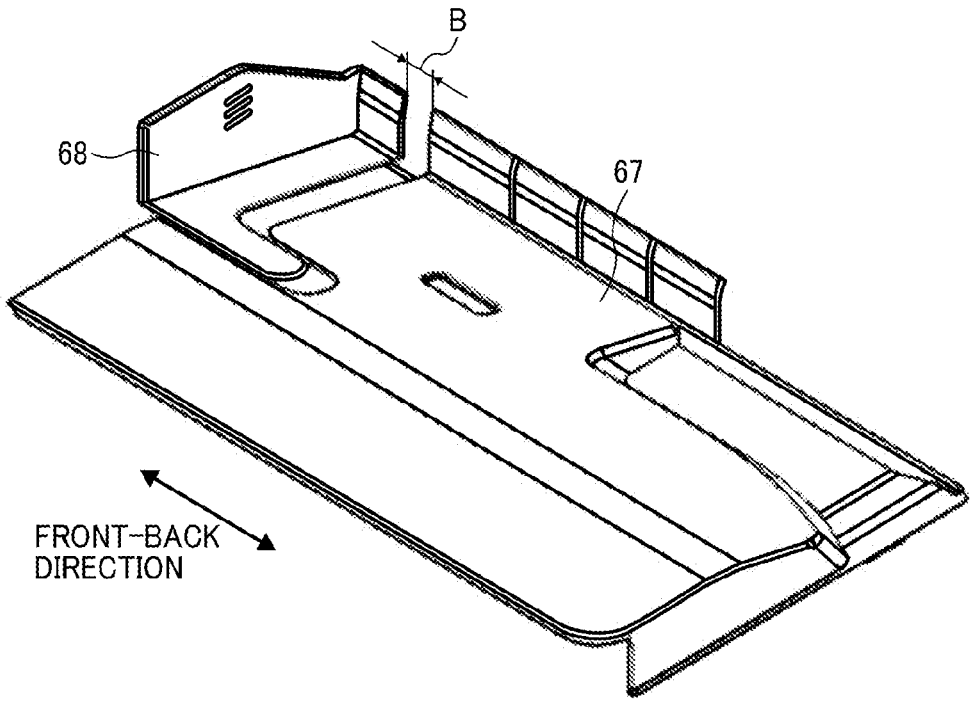
B
68
67
FRONT-BACK
DIRECTION

FIG. 5B

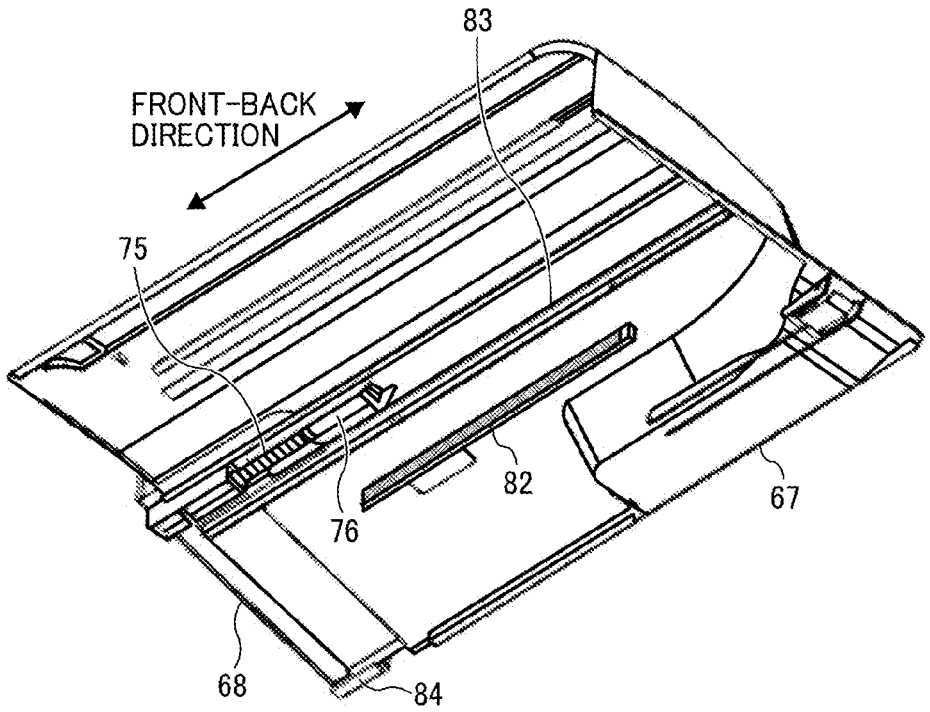
83
FRONT-BACK
DIRECTION
75
82
67
76
68
84

FIG. 6

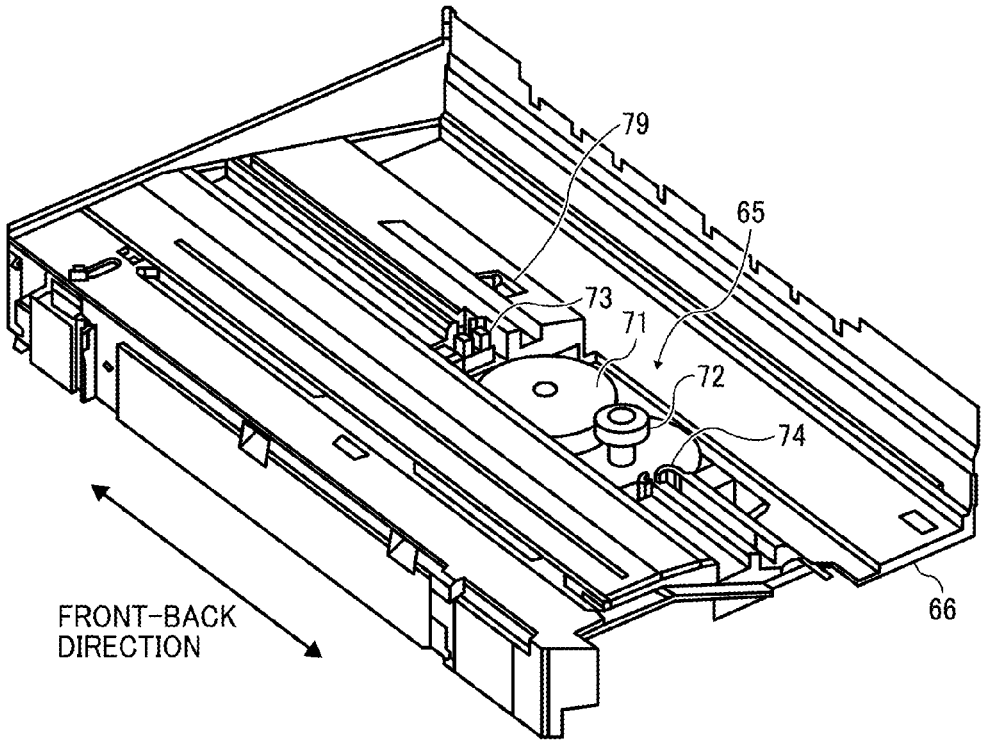

FIG. 7

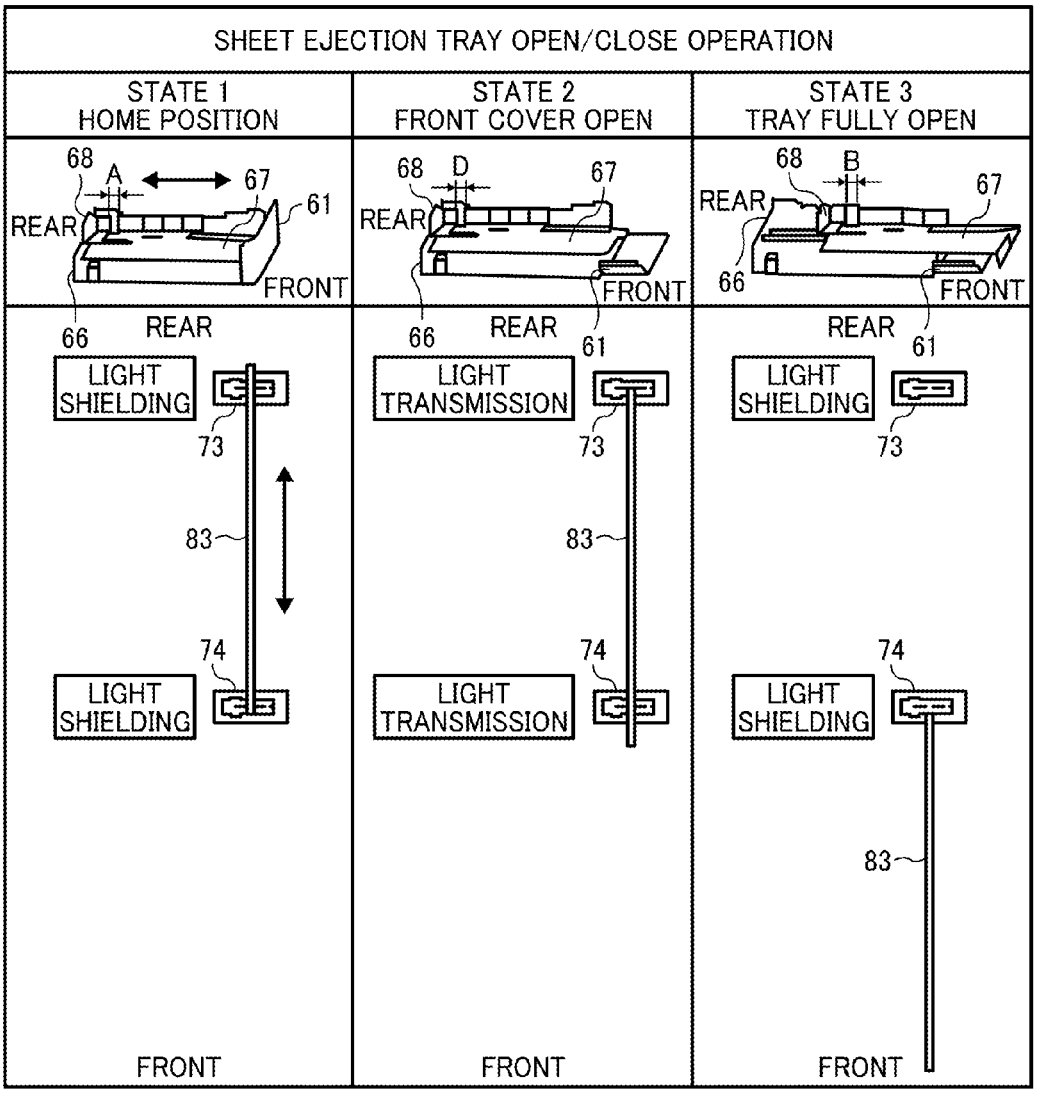
SHEET EJECTION TRAY OPEN/CLOSE OPERATION
STATE 1
HOME POSITION
STATE 2
FRONT COVER OPEN
STATE 3
TRAY FULLY OPEN
68
A
67
61
REAR
FRONT
68
D
67
REAR
FRONT
68
B
67
REAR
66
FRONT
66
REAR
LIGHT SHIELDING
73
83
74
LIGHT SHIELDING
FRONT
66
REAR
61
LIGHT TRANSMISSION
73
83
74
LIGHT TRANSMISSION
FRONT
REAR
61
LIGHT SHIELDING
73
74
LIGHT SHIELDING
83
FRONT

FIG. 8A

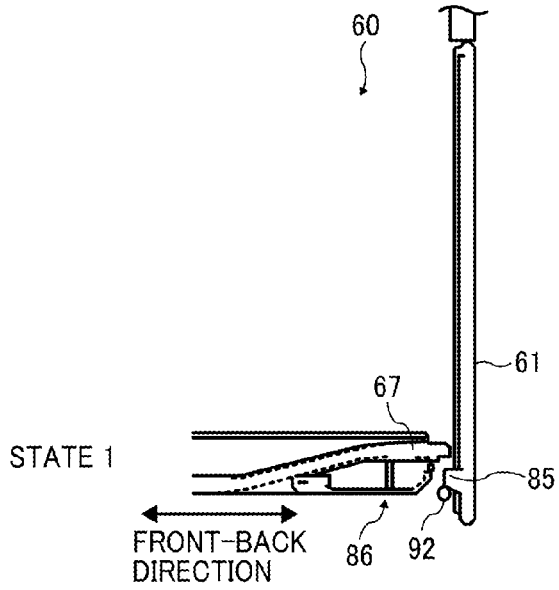

FIG. 8B

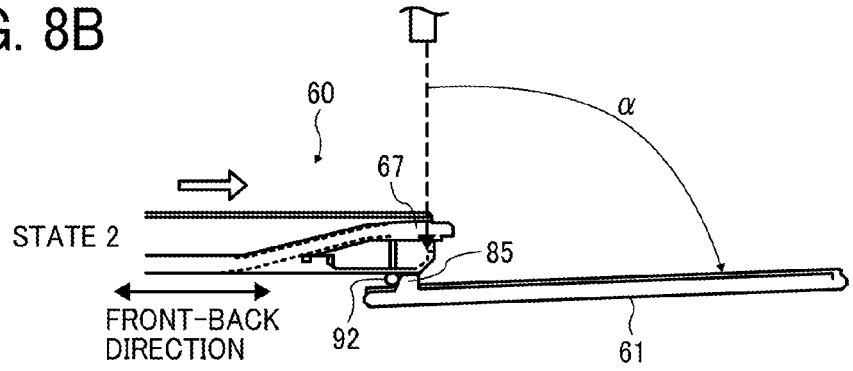

FIG. 8C

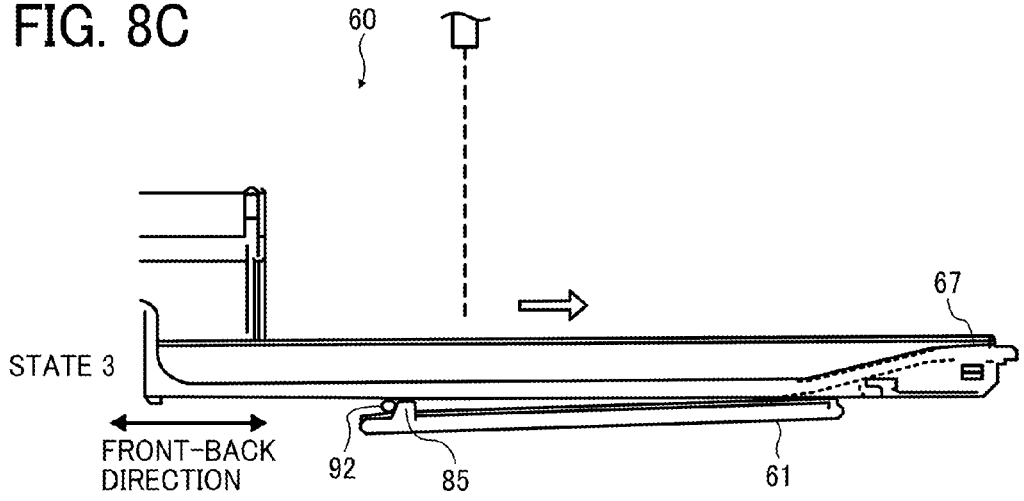

FIG. 9

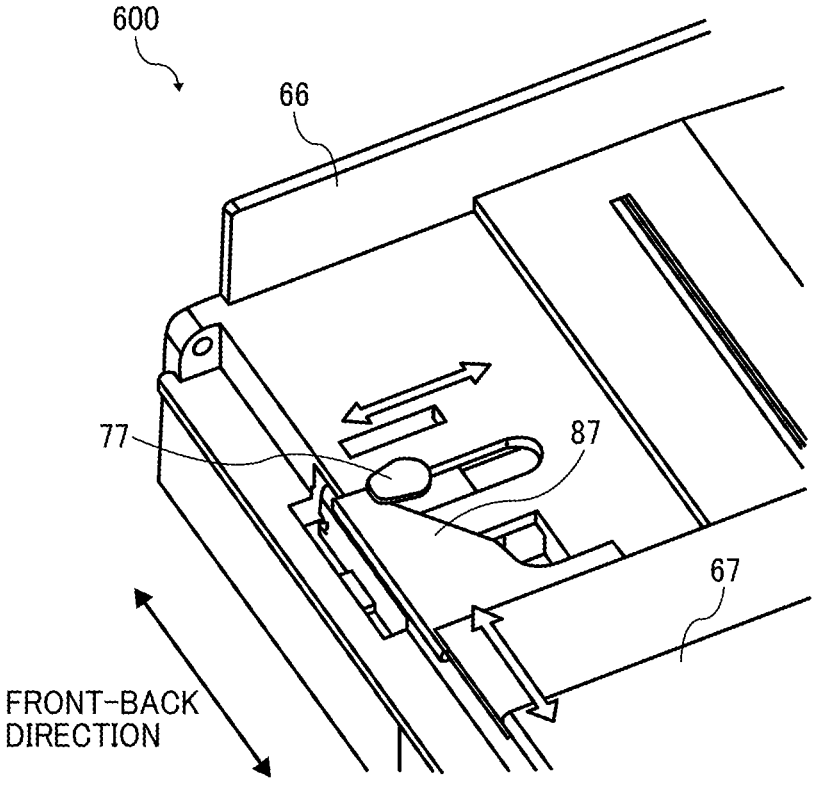

FIG. 10

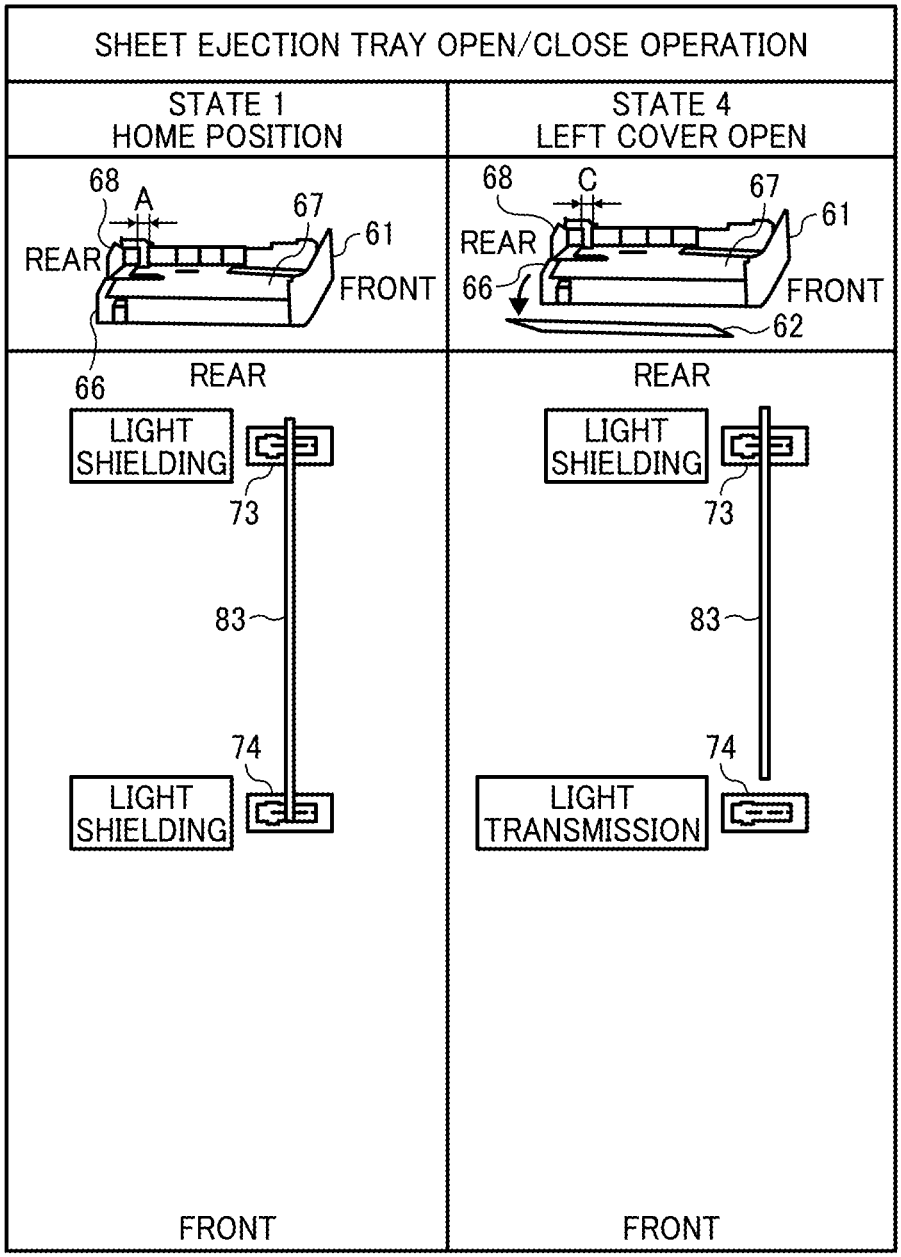
SHEET EJECTION TRAY OPEN/CLOSE OPERATION
STATE 1
HOME POSITION
STATE 4
LEFT COVER OPEN
68
A
67
61
REAR
FRONT
66
68
C
67
61
REAR
66
FRONT
62
REAR
66
LIGHT SHIELDING
73
83
74
LIGHT SHIELDING
FRONT
REAR
LIGHT SHIELDING
73
83
74
LIGHT TRANSMISSION
FRONT

FIG. 11C

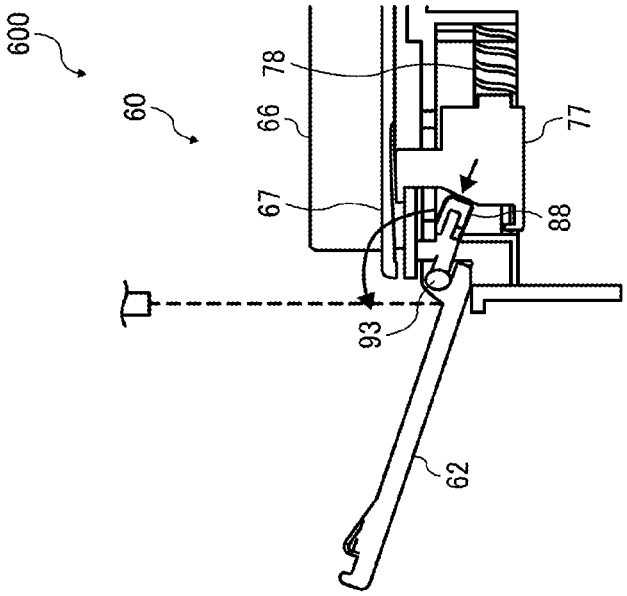

FIG. 11B

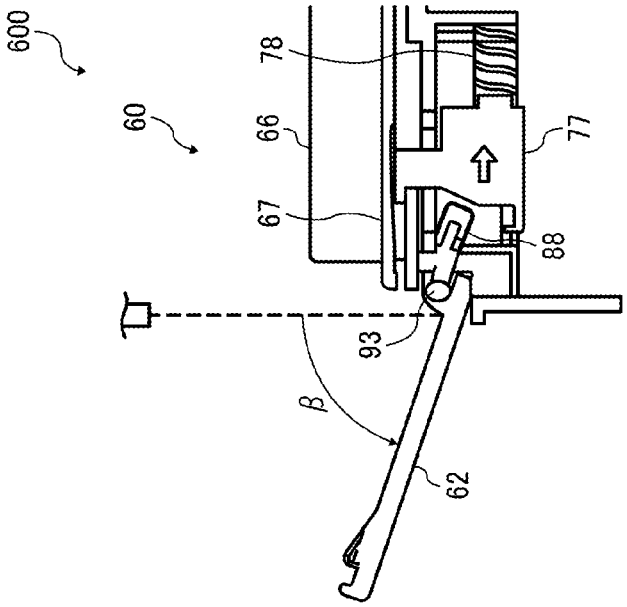

FIG. 11A

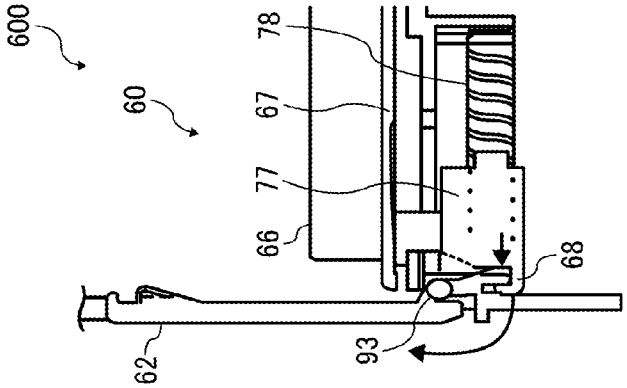

FIG. 12A

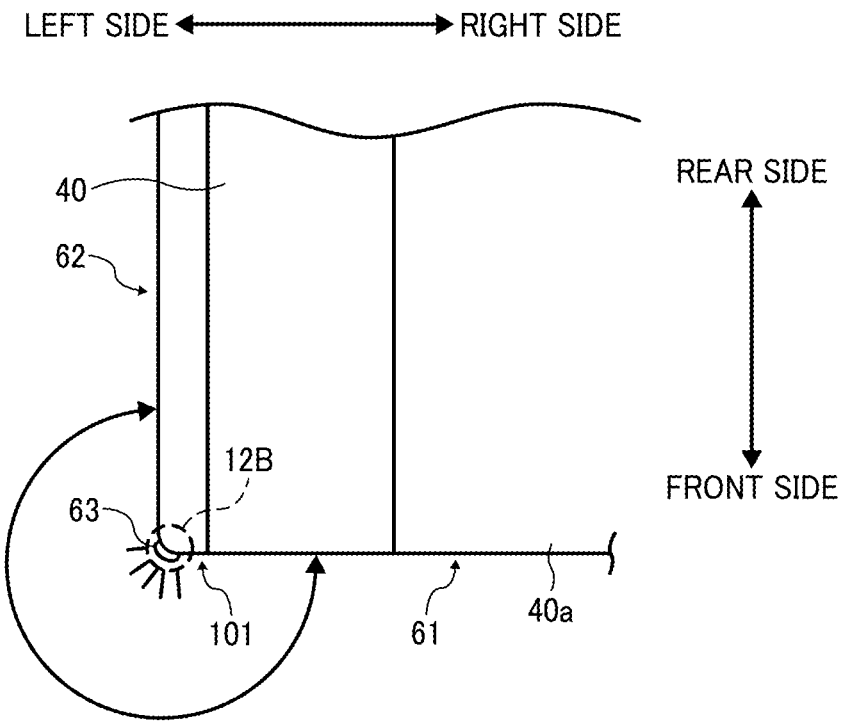

FIG. 12B

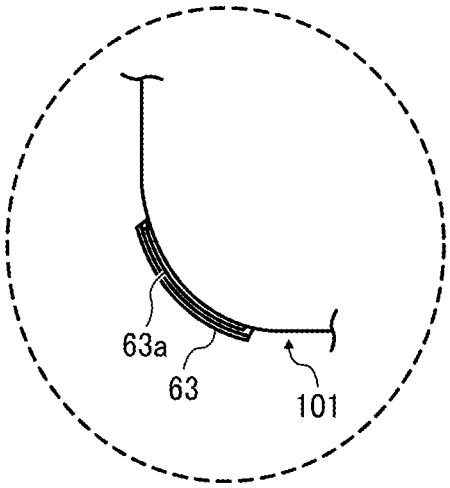

IMAGE FORMING APPARATUS

CROSS-REFERENCE TO RELATED APPLICATIONS

The present application claims priority pursuant to 35 U.S.C. §119(a) from Japanese patent application number 2014-004123, filed on Jan. 14, 2014, the entire disclosure of which is hereby incorporated by reference herein.

BACKGROUND

1. Technical Field

Exemplary embodiments of the present invention relates to an image forming apparatus such as a printer, a facsimile machine, or a copier.

2. Background Art

Conventionally, image forming apparatuses including an inner sheet ejection unit disposed between an image reading unit to read an image of an original and an image forming unit to form an image on a sheet of paper, are known. The sheet of paper on which the image is formed is ejected onto the inner sheet ejection unit, which is enclosed by walls and is disposed inside the apparatus with one open side.

For example, conventional image forming apparatuses include an image forming unit disposed substantially in the middle of the apparatus body, and an image reading unit to read an image of the original above the image forming unit, with a predetermined space between the image reading unit and the image forming unit in which there is provided an inner sheet ejection unit having a sheet ejection tray onto which the sheet after image formation is ejected. This space-saving layout makes the apparatus more compact. In addition, the sheet ejected onto the sheet ejection tray of the inner sheet ejection unit can be removed from the open side manually.

SUMMARY

In one embodiment of the disclosure, there is provided an improved image forming apparatus that includes an apparatus body; an image forming unit to form an image on a sheet member; and a sheet ejection container including a sheet ejection tray on which the sheet member ejected from the apparatus body is stacked. At least one side of the apparatus body is open and the sheet ejection container is disposed inside the apparatus body at the open side. The sheet ejection tray is configured to be movable between a first position in the sheet ejection container, where the sheet member is ejected to the sheet member tray, and a second position nearer to the open side than the first position.

These and other objects, features, and advantages of the present invention will become apparent upon consideration of the following description of the preferred embodiments of the present invention when taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** illustrates a schematic configuration of an image forming apparatus according to an embodiment of the present invention;

FIG. **2** illustrates a perspective view of the image forming apparatus according to an embodiment of the present invention;

FIG. **3** is a perspective view of an inner tray of the apparatus;

FIG. **4** is a cross-sectional view of the inner tray seen from the front of the apparatus;

FIG. **5**A is a perspective view of the sheet ejection tray seen from a platen on which the sheet is placed; and FIG. **5**B is a perspective view of the sheet ejection tray seen from a rear of the tray;

FIG. **6** is a perspective view of a sheet ejection frame;

FIG. **7** shows states of the front cover and the sheet ejection tray in operation;

FIG. **8**A shows positions of a front cover and a sheet ejection tray in a state **1** of FIG. **7**; FIG. **8**B shows positions of the same in a state **2** of FIG. **7**; and FIG. **8**C shows positions of the same in a state **3** of FIG. **7**;

FIG. **9** is a schematic view of an opening/closing assembly to open and close a left cover;

FIG. **10** shows states of the left cover and the sheet ejection tray in the operation;

FIG. **11**A shows positions of the left cover and the sheet ejection tray in a state **1** of FIG. **10**; FIG. **11**B shows a state in which the sheet ejection tray moves from a home position to the rear of the apparatus; and FIG. **11**C shows a state in which the sheet ejection tray moves from the rear to the front of the apparatus; and

FIGS. **12**A and **12**B illustrate a switch for opening and closing the covers.

DETAILED DESCRIPTION

Preferred embodiments of an image forming apparatus employing electrophotography will be described. However, it is to be noted that the present invention is also applicable to an image forming apparatus employing an inkjet printing method.

FIG. **1** illustrates a schematic configuration of an image forming apparatus **100** according to an embodiment of the present invention. As illustrated in FIG. **1**, the image forming apparatus **100** according to the present embodiment includes an image forming unit **20** in an interior of an apparatus body **10**.

An automatic document feeder (ADF) **40** and a scanner **30** are disposed at an upper part of the apparatus body **10**. A bundle of originals is placed on a tray **40***a* of the ADF **40**. The ADF **40** separates and conveys each sheet one by one to the scanner **30**. The scanner **30** reads an image on the original conveyed by the ADF **40**.

The image forming unit **20** includes a photoconductor **21**, a charger **22** including a charging roller, a writing device **23**, a developing device **24**, a toner supply device **25**, a transfer roller **26**, a cleaning device **27** including a cleaning roller, a discharger, and a fixing device **28**. The fixing device **28** includes a heat roller **28***a* and a pressure roller **28***b*, both of which are pressed each other.

In addition, a paper tray **13** containing a plurality of sheets P is disposed in the bottom of the apparatus body **10**. The paper tray **13** is provided with a sheet feed roller **14**, and the like.

A sheet conveyance path R**1** to convey the sheet P from the paper tray **13** to an upper, sheet ejection tray **67** is defined by surrounding components inside the apparatus body **10**. A pair of registration rollers **18** is disposed in the sheet conveyance path R**1** between the paper tray **13** and the photoconductor **21**. A pair of sheet ejection rollers **19** is disposed at the end of the conveyance path R**1**.

In the image forming unit **20**, first, a surface of the photoconductor **21** is uniformly charged by the charger **22** simultaneously with a rotation of the photoconductor **21**. The optical writing device **23** exposes a surface of the

photoconductor **21** with laser beams and optically writes an image thereon based on image data input from a personal computer or image data read by the scanner **30**, and forms an electrostatic latent image on a surface of the photoconductor **21**. Then, toner is adhered onto the electrostatic latent image by the developing device **24** and the latent image is rendered visible, so that a toner image is formed on the photoconductor **21**.

On the other hand, the sheet feed roller **14** separates each sheet P one by one and conveys each sheet. Each sheet abuts a pair of registration rollers **18** and stops. The sheet P that stops by abutting the pair of registration rollers **18** is further conveyed to a transfer section where the photoconductor **21** and the transfer roller **26** are disposed opposite each other at a matched timing of the toner image formation by the image forming unit **20**.

In the transfer section, a transfer electric field is formed between the photoconductor **21** and the transfer roller **26**, and the toner image formed on the photoconductor **21** is transferred onto the sheet P by the transfer electric field. The heat roller **28***a* and the pressure roller **28***b* of the fixing device **28** apply heat and pressure to the sheet P on which the toner image has been transferred, so that the toner image thereon is fixed onto the sheet P with heat and pressure. The sheet P onto which the toner image is fixed is then ejected to the sheet ejection tray **67** by the pair of sheet ejection rollers **19**.

A center alignment method is applied to the present embodiment, in which the sheet P is ejected onto the ejection tray **67** with a center of the sheet P in a direction perpendicular to the sheet conveyance direction set as a reference, regardless of the size of the sheet P used. On the other hand, the surface of the photoconductor **21** on which the residual toner after the toner image transfer remains is cleaned by the cleaning device **27**, is electrically discharged by a discharger, and is readied for the next image formation.

FIG. **2** illustrates a perspective view of the image forming apparatus **100** according to an embodiment of the present invention.

An inner tray **60** is disposed in an internal area between the scanner **30** and the image forming unit **20** of the image forming apparatus **100**. The inner tray **60** is enclosed top and bottom but includes at least one open side.

More specifically, in the present embodiment, a left wall of the inner tray **60** downstream in the sheet ejection direction when the sheet P is ejected to the sheet ejection tray **67** from an interior of the apparatus body and a front wall of the apparatus in the direction perpendicular to the sheet ejection direction are open.

Further, an openably closable front cover **61** and a left cover **62** are disposed to cover the inner tray **60**. The front cover **61** and the left cover **62** are hinged and pivot about the hinge relative to the apparatus body **10**.

A control panel **64** and a switch **63** are disposed on the side wall of the scanner **30** above the front cover **61**. The switch **63** is used by a user to open or close the front cover **61** and the left cover **62**. In addition, including controls on the operation of the front cover **61** and the left cover **62**, a controller disposed inside the apparatus body **10** controls the whole operation of the image forming apparatus **100**.

Herein, to make the apparatus more compact and to have higher printing capability, it is preferred that a height of the inner tray **60** be reduced, and that a shorter-side of the sheet be conveyed in parallel with the sheet conveyance direction, that is, a so-called long edge feed (LEF) method. As a result, the image forming apparatus **100** according to the present embodiment conveys the sheet P by the LEF method from the paper tray **13** to the inner tray **60** via the image forming unit **20**.

However, because the image forming apparatus **100** should have greater depth in the distal-proximal direction (or front-back direction) in this case, a distance from the front of the apparatus to the sheet ejection center inside the inner tray **60** becomes longer than that in a case of employing a so-called short edge feed (SEF) method, in which a longer-side of the sheet is conveyed in parallel with the sheet conveyance direction. As a result, a length of the scanner **30** disposed above the inner tray **60** and covering the sheet P lengthens, so that the small-sized sheet P ejected and present inside the inner tray **60** is not so visible and cannot be removed from the inner tray **60** easily.

Note that the size of the surface of the sheet ejection tray **67** and of the platen on which the sheet P is placed is, when the sheet P is ejected onto the sheet ejection tray **67** by the LEF method, the size capable of accommodate A**4**-size sheet P and unable to accommodate A**3**-size sheet P.

More specifically, by ejecting the sheet P onto the sheet ejection tray **67**, the width of the platen of the sheet ejection tray **67** in the sheet ejection direction from the pair of sheet ejection rollers **19** to the sheet ejection tray **67** is longer than a shorter-side of the A**4**-size sheet P and shorter than a shorter-side of the A**3**-size sheet P. On the other hand, the width of the platen of the sheet ejection tray **67** in the direction perpendicular to the sheet ejection direction is longer than a longer-side of the A**3**-size sheet P.

FIG. **3** is a perspective view of the inner tray **60**. FIG. **4** is a cross-sectional view of the inner tray **60** seen from the front of the apparatus. FIG. **5**A is a perspective view of the sheet ejection tray **67** seen from the platen on which the sheet P is placed.

A sheet ejection frame **66** of the inner tray **60** is secured to the apparatus body **10**. In addition, below the sheet ejection frame **66** of the inner tray **60**, a sheet ejection tray driver **65** including a drive motor **70**, reduction gears, and a sheet ejection sensor **79** to detect the sheet P on the sheet ejection tray **67**, are disposed.

The front cover **61** is hinged at the sheet ejection frame **66** along the bottom side thereof, and is constantly biased by a torsion spring toward a closing direction. In addition, similarly to the front cover **61**, the left cover **62** is hinged at the sheet ejection frame **66** along the bottom side thereof, and a linking device, which will be described later, constantly biases the left cover **62** toward a direction to close the left cover **62**.

The front cover **61** and the left cover **62** are closed relative to the apparatus body **10** to seal off a space inside the inner tray **60**.

A guide **80** to prevent backlash in lateral directions of the apparatus and guide the sheet ejection tray **67** to move in the distal-proximal direction of the apparatus is disposed on a rear of the sheet ejection tray **67**. A plurality of rails **81** to adjust a vertical position of the sheet ejection tray **67** and guide movement of the sheet ejection tray **67** in the distal-proximal direction of the apparatus, is disposed on the rear of the sheet ejection tray **67**. The guide **80** and the rails **81** engage guide rails **91** disposed on the sheet ejection frame **66** and are held by the sheet ejection frame **66** to be movable in the distal-proximal direction of the apparatus alone.

A rack gear **82** is also disposed on the rear of the sheet ejection tray **67** and engages a tray drive gear **72** included in the reduction of the sheet ejection tray driver **65**. Driving force of the drive motor **70** of the sheet ejection tray driver **65** is reduced by an idler gear **71** and the tray drive gear **72**,

both included in the reduction gears, and is transmitted to the rack gear **82**, so that the sheet ejection tray **67** can be moved in the distal-proximal direction of the apparatus.

In addition, because an internal gear is used for the idler gear **71** that connects to the drive motor **70**, a quiet, reliable drive transmission is provided. In addition, the drive transmission between the drive motor **70** and the idler gear **71** can be performed by a friction transmission using a V-belt, a flat belt, or a rubber roller.

FIG. **5**B is a perspective view of the sheet ejection tray **67** seen from the rear of the tray. As illustrated in FIG. **5**B, a guide shaft **76** is fixed at around one end of an end fence **68**, passes through an engagement hole disposed on the sheet ejection tray **67** with a compression spring **75** sandwiched, and is stopped by an E-type retaining ring. A rail-shaped regulator **84** that holds and pinches the end of the sheet ejection tray **67** to regulate movement of the end fence **68** that pivots about the guide shaft **76** is disposed at the other end of the end fence **68**.

When the sheet ejection tray **67** positions at a home position, a distance between the end fence **68** and the sheet ejection tray **67** is a distance A (see FIG. **7**) in the distal-proximal direction of the apparatus. When the end fence **68** slides along the rail-shaped regulator **84**, the end fence **68** can move to a position where the distance between the end fence **68** and the sheet ejection tray **67** becomes a distance B as illustrated in FIG. **5**A in the distal-proximal direction of the apparatus.

Next, controlling the position of the sheet ejection tray **67** will be described.

FIG. **6** is a perspective view of the sheet ejection frame **66**. FIG. **7** shows states of the front cover **61** and the sheet ejection tray **67** in the operation. As illustrated in FIG. **6**, a first position sensor **73** and a second position sensor **74** each to detect a position of the sheet ejection tray **67** are disposed near the sheet ejection tray driver **65** of the sheet ejection frame **66**. Each of the first position sensor **73** and the second position sensor **74** is an optical sensor including a light-emitting part and a light receiving part, and each detects whether the light emitted from the light-emitting part to the light receiving part is blocked by a feeler **83** (shown in FIG. **5**B) disposed on the rear surface of the sheet ejection tray **67** or received by the light receiving part without being blocked by the feeler **83**.

As shown in Table 1, the position of the sheet ejection tray **67** is determined from a combination of the readings concerning the first position sensor **73** and the second position sensor **74**, change in the state of the sheet ejection tray **67**, and information on the previous movement, so that the position of the sheet ejection tray **67** can be controlled.

TABLE 1

State	First position sensor 73	Second position sensor 74	Previous movement of tray
State 1	Light blocked	Light blocked	Moved to state 1 in the previous time
State 2	Light blocked	Light	Moved to state 2 or immediately after power on in the previous time
State 3	Light transmitted	Light transmitted	No data
State 4	Light blocked	Light transmitted	No data
State 5	Light transmitted	Light blocked	No data

A "change in state" means a change between each state including "state **1**", "state **2**", and "state **3**" as illustrated in FIG. **7**. Alternatively, the positional control of the sheet ejection tray **67** can be performed based on only a combination of the readings from the first position sensor **73** and the second position sensor **74**.

It is to be noted that the image forming apparatus **100** according to the present embodiment employs two sensors to detect positions of the sheet ejection tray **67** to reduce costs. To determine a position of the sheet ejection tray **67** more accurately, one more sensor to detect a home position of the sheet ejection tray **67** can be added and the position of the sheet ejection tray **67** can be determined using readings from a total of three sensors.

Next, referring to FIG. **1**, an operation of the front cover **61** and a movement of the sheet ejection tray **67** will be described. In the image forming apparatus **100** according to the present embodiment, when the sheet P is ejected onto the sheet ejection tray **67** via the LEF method, the front cover **61** is opened when the sheet P in the sheet ejection direction is shorter than the width of the sheet ejection tray **67** in the sheet ejection direction.

FIG. **8**A shows a position of the front cover **61** and the sheet ejection tray **67** in the state **1** of FIG. **7**. In the state **1** in which the sheet ejection tray **67** positions at the home position, the sheet ejection tray **67** and the front cover **61** do not contact each other, and the front cover **61** is closed.

The end fence **68** contacts a wall in the distal side of the apparatus of the inner tray **60**, and the distance between the sheet ejection tray **67** and the end fence **68** in the distal-proximal direction of the apparatus is the distance A that is shorter than the distance B.

FIG. **8**B shows a position of the front cover **61** and the sheet ejection tray **67** in the state **2** of FIG. **7**. Due to the driving force of the sheet ejection tray driver **65**, the sheet ejection tray **67** is moved from the home position toward the front of the apparatus, the front end of the sheet ejection tray **67** abuts a position higher than a rotary shaft **92** of the front cover **61**, so that the front cover **61** is pushed to open.

Then, when the sheet ejection tray **67** moves to the front of the apparatus by a distance D or more, a contact surface **86** disposed on the sheet ejection tray **67** parallel to a sliding direction and a cam-shaped part **85** of the front cover **61** contact. With this structure, as illustrated in FIG. **8**B, an open angle of the front cover **61** becomes a maximum angle α, and the cover arrives at the state **2** as illustrated in FIG. **7**.

Herein, when the distances A, B, and D satisfy a relation D=/>B-A, the front cover **61** takes a maximum angle α and the end fence **68** keeps the most distal position in the inner tray **60** in the state **2**. With this structure, in the state **2**, the front cover **61** is open, the sheet P can be removed from the inner tray **60**, and the sheet P can be ejected to the sheet ejection tray **67** continuously.

Accordingly, after a print job involving normal sheet sizes such as A**4**-size and B**4**-size is completed, the positions of the front cover **61** and the sheet ejection tray **67** are brought to the state **2**, so that the sheet ejection tray **67** approaches an opening formed in the front of the apparatus than the home position in the state **1**.

With this structure, visibility of the sheet P ejected onto the sheet ejection tray **67** can be improved and the sheet P can be removed more easily than a case in which the sheet ejection tray **67** positions at the home position at a more distal side than the position of the state **2**.

During printing, the front cover **61** is closed to reduce noise and odor. When removing the sheet P, the front cover **61** is open and the sheet ejection tray **67** is positioned at the state **2**, thereby improving the visibility of the sheet P and operability. In addition, without stopping the next print job,

the sheet P can be ejected onto the sheet ejection tray **67**. With this structure, the image forming apparatus **100** with better performance can be provided.

FIG. **8**C shows a position of the front cover **61** and the sheet ejection tray **67** in the state **3** of FIG. **7**. When the sheet ejection tray **67** further advances from the position in the state **2**, the sheet ejection tray **67** reaches a position where the tray is fully open as illustrated in FIG. **8**C and the state **3** of FIG. **7**.

When the sheet ejection tray **67** moves by more than the distance D from the home position, the open angle of the front cover **61** remains at the maximum angle α constantly regardless of moving amount of the sheet ejection tray **67** and the exposed amount of the sheet ejection tray **67** from the inner tray **60** alone changes. The sheet ejection tray **67** stops when the tray is fully open.

After completion of a print job involving a small-sized sheet such as a postcard, the front cover **61** and the sheet ejection tray **67** are brought to the state **3** from the state **1**. With this structure, compared to a state in which the sheet ejection tray **67** positions at the home position in the distal end, the visibility of the sheet P on the sheet ejection tray **67** can be improved and the sheet P can be removed easily in the state **3** where most part of the sheet ejection tray **67** is exposed outside the opening disposed on the front wall of the apparatus.

In the printing, the front cover **61** is closed to reduce noise and odor. When removing the sheet P, the front cover **61** is open and the sheet ejection tray **67** is positioned at the state **3**, thereby improving the visibility of the small-sized sheet P and operability.

When removing the small-sized sheet from the sheet ejection tray **67**, even though the sheet P is pushed to the depths of the inner tray **60**, the end fence **68** stops the sheet at a certain position around the distal-proximal direction center of the apparatus, and thus, the sheet can be removed from the inner tray **60**. On the other hand, when the front cover **61** and the sheet ejection tray **67** are moved from the state **3** to the state **1** of FIG. **7**, the sheet ejection tray driver **65** allows the sheet ejection tray **67** to move from the tray full-open position to the home position.

When the sheet ejection tray **67** reaches the home position, the front cover **61** is rotated to a closing direction manually relative to the apparatus body **10** and the front cover **61** is closed. Alternatively, the front cover **61** can be configured to automatically rotate to a closing direction relative to the apparatus body **10**.

FIG. **9** shows an opening/closing assembly **600** to open and close the left cover **62**. FIG. **10** shows states of the left cover **62** and the sheet ejection tray **67** in the operation. As shown in Table 1, the position of the sheet ejection tray **67** is determined from a combination of the readings from the first position sensor **73** and the second position sensor **74**, change in the state of the sheet ejection tray **67**, and information on the previous movement, so that the position of the sheet ejection tray **67** can be controlled.

FIG. **11**A shows positions of the left cover **62** and the sheet ejection tray **67** in the state **1** of FIG. **10**. In the state **1** in which the sheet ejection tray **67** positions at the home position, the left cover **62** includes a hook portion **88** disposed below the rotary shaft **93**, a left cover pressure spring **78** biases a hook portion **88** via a biasing member **77**. Thus, the left cover **62** maintains a closed state.

When the sheet ejection tray **67** moves to the rear of the apparatus from the home position by the sheet ejection tray driver **65**, the biasing member **77** moves right by a left cam-shaped portion **87** disposed on the sheet ejection tray **67** as illustrated in FIG. **11**B. The left cover **62** is rotated about the rotary axis **93** to an opening direction relative to the apparatus body **10** until the hook portion **88** of the left cover **62** is disengaged from the biasing member **77**.

With this structure, the left cover **62** is applied with an initial speed toward the opening direction, gravitational center of the left cover **62** positions outside the apparatus than the rotary axis **93**, so that the left cover **62** automatically opens to a maximum open angle β and is held with its own weight, and the cover arrives at a state **4** of FIG. **10**.

When the sheet ejection tray **67** moves to the front of the apparatus from the state **4** of FIG. **10** drawn by the sheet ejection tray driver **65**, the biasing member **77** contacts a position of the hook portion **88** to bias the left cover **62** to an opening direction as illustrated in FIG. **11**C. Thus, the left cover **62** maintains an open state.

The opening of the left cover **62** allows the sheet ejection tray driver **65** to open the left cover **62** automatically and bring the state **1** to the state **4** of FIG. **10** upon detecting that a print job using a long-size sheet P such as an A**3**-size sheet that cannot be accommodated in the sheet ejection tray **67**.

This is because when the A**3**-size sheet is ejected to the sheet ejection tray **67** by the SEF method, the length of the sheet P in the sheet ejection direction becomes longer than the width of the sheet ejection tray **67** in the sheet ejection direction to the sheet ejection tray **67**, and accordingly, in the state in which the left cover **62** is closed, the A**3**-side sheet P cannot be ejected to the sheet ejection tray **67**.

In addition, when the left cover **62** is open, because the left cover **62** functions as an extension tray, even the A**3**-size sheet P can be stacked on the sheet ejection tray **67** and the left cover **62**. With this structure, a relatively quiet, low-odor image forming apparatus **100** is provided when the left cover **62** is closed during printing, and a long-size sheet such as the A**3**-size sheet P can be stacked on the sheet ejection tray in a compact body.

According to an embodiment of the present invention, the front cover **61** and the left cover **62** can be open or closed by a driving force from the drive motor **70** as a single drive source disposed on the sheet ejection tray driver **65**. With this structure, an apparatus can be provided that is less expensive than a case in which a plurality of drive motors is provided for each of the front cover **61** and the left cover **62**.

Referring now to FIGS. **12**A and **12**B, the switch **63** for opening and closing the covers will be described in greater detail.

In the image forming apparatus **100** according to the present embodiment, the operation of the sheet ejection tray **67** and the front cover **61** is set to be operated in conjunction with the print job, and further, the sheet ejection tray **67** and the front cover **61** can be open or closed by pushing the switch **63**.

With this structure, the sheet P ejected to the inner tray **60** can be removed without any concern whether the printing is being performed or not, so that user-friendliness is improved.

In the present embodiment, the switch **63** is disposed on the left-front exterior wall **101** adjacent to the front cover **61** that positions at the front of the apparatus, and is molded with transmission resins. In addition, an LED **63***a*, a light-emitting diode, is disposed in an interior of the switch **63**. Then, the LED **63***a* illuminates the switch **63** to thus prompt pressing of the switch **63**.

In addition, as illustrated in FIG. **12**, the switch **63** is disposed to cross a boundary of the front and the left side of the apparatus. As a result, the switch **63** is visible through a range extending over 270 degrees excluding the right-rear of

the apparatus. As a result, design flexibility of the image forming apparatus **100** can be drastically improved.

In the present embodiment, the sheet ejection tray **67** and the end fence **68** are movably allocated; however, by making the end fence **68** alone movable, the sheet P can be pulled toward the front of the apparatus.

The aforementioned embodiments are examples and specific effects can be obtained for each of the following aspects of A to H:

<Aspect A>

An image forming apparatus **100** includes an image forming unit **20** to form an image on a sheet member such as a sheet P, and a sheet ejection container such as an inner tray **60** including a sheet member stacking part such as a sheet ejection tray **67** on which the sheet member ejected from an apparatus body is stacked. At least one side of the apparatus body is open and the inner tray **60** is disposed inside the apparatus. The sheet ejection tray **67** is configured to be movable between a first position in the sheet ejection container where the sheet member is ejected to the sheet member stacking part and a second position nearer to the opening than the first position.

In Aspect A, the sheet member stacking part is moved from the first position to the second position and the sheet member stacking part can approach the opening. With this structure, compared to a state in which the sheet ejection tray **67** positions at the home position in the distal end from the opening than the second position, the visibility of the sheet P on the sheet ejection tray **67** can be improved and the sheet P can be removed easily.

<Aspect B>

In Aspect A, a sheet ejection tray driver **65** to move the sheet member stacking part (that is, the sheet ejection tray **67**) between the first position and the second position is disposed. With this structure, as described in the above embodiments, the sheet ejection tray driver **65** automatically moves the sheet ejection tray **67**, so that the handling to move the sheet ejection tray **67** manually can be saved.

<Aspect C>

In the aspects A and B, a regulating member such as an end fence **68** is disposed on the sheet member stacking part. The end fence **68** is disposed perpendicular to the sheet member conveyance direction relative to the platen of the sheet member stacking part and is movable in the sheet conveyance perpendicular direction. The end fence **68** contacts and stops one end of the sheet in the conveyance perpendicular direction of the sheet placed on the platen, thereby preventing the sheet member from entering into the depth of the sheet ejection container.

<Aspect D>

In any one of the aspects A to C, cover members to cover at least one opening of the sheet ejection container so as to be openably closable and a switch to open or close the cover members are disposed. With this structure, when the cover member is closed in the printing operation, noise and odor can be reduced.

<Aspect E>

In the aspect D, the sheet ejection container includes at least one opening disposed downstream in the sheet ejection direction when the sheet member is ejected from an inside of the apparatus to the sheet member stacking part, and downstream in the moving direction of the sheet member stacking part moving from the first position to the second position in the direction perpendicular to the sheet member ejection direction. The cover members includes a first cover such as the left cover **62** to open or close the opening disposed downstream in the sheet ejection direction of the sheet ejection container, and a second cover such as the front cover **61** to open or close the opening disposed downstream in the moving direction of the sheet member stacking part. When the length of the sheet member in the sheet member conveyance direction is longer than the width of the sheet member stacking part in the sheet member ejection direction, the first cover is released to open. By contrast, when the length of the sheet member in the sheet member conveyance direction is shorter than the width of the sheet member stacking part in the sheet member ejection direction, the second cover is released to open. With this structure, as described in the above embodiments, the noise and odor in the printing operation is reduced, and visibility of the sheet member when using a small-sized sheet can be improved and the small-sized sheet can be removed easily, as well as the large-sized sheet can be ejected onto the sheet ejection container.

<Aspect F>

In Aspect E, the first cover and the second cover are open or closed via a driving force from a single drive source that the open/close means or the sheet ejection driver includes. With this structure, as described in the above embodiments, a low cost apparatus can be provided than a case in which a plurality of drive sources corresponding to respective covers is provided.

<Aspect G>

In any of the aspects D, E, and F, and switch **63** to open or close the cover member via the sheet ejection driver is disposed. With this structure, as described in the above embodiments, the sheet member ejected onto the sheet ejection container can be removed by the user without any concern whether the printing is being performed or not, so that a user-friendliness is improved.

<Aspect H>

In Aspect G, the switch **63** is disposed on the left-front exterior wall **101** adjacent to the front cover **61** that positions at the front of the apparatus, and an LED **63***a*, a light-emitting diode, is disposed in an interior of the switch **63**. With this structure, the LED **63***a* illuminates the switch **63** to thus prompt the user to notice a state of the apparatus and to press the switch **63** down.

Furthermore, the exemplary embodiments of the present invention are not only applied to the type of image forming apparatus that includes the image forming unit and the image reading unit disposed above and below the sheet ejection portion alone. Instead, the sheet ejection tray is formed in any space inside and in the middle of the apparatus, the sheet is ejected onto the sheet ejection tray, and the ejected sheet is removed from an opening formed on a side wall of the apparatus body.

For example, the present embodiments can be applied to such a type of printer that the image forming unit is disposed at an upper part of the body of the printer, a paper tray is disposed at a bottom of the printer, and a space is formed between the image forming unit and the paper tray. The space includes at least one opening among side walls of the printer, and a sheet ejection portion having a sheet ejection tray is disposed in the above space.

Alternatively, the present embodiments can be applied to a structure in which the sheet ejection portion is not surrounded by an upper wall or a bottom wall and the sheet is ejected to the sheet ejection tray of such a sheet ejection portion. That is, the present embodiments can be applied to a printer that includes the sheet ejection portion disposed at an upper side with at least one open side and without an upper wall, and a sheet is ejected to the sheet ejection tray of such a sheet ejection portion with at least one open side

and without an upper wall. Accordingly, even though a book shelf is disposed near an upper portion of the sheet ejection portion, because the sheet ejection tray can be moved to positions in the state **2** or **3** nearer to the opening than the home position in the state **1**, visibility of the sheet ejected on the sheet ejection tray can be improved and the sheet can be removed without any difficulty.

The present embodiments can further be applied to a printer or a multifunction peripheral including a sheet ejection portion disposed in the bottom of the printer or apparatus, with at least one open side and without a bottom wall. For example, the sheet ejection tray is disposed between a floor or stand on which the image forming apparatus is placed and an upper wall surrounding the sheet ejection portion, and the sheet ejection tray is moved to positions in the state **2** or **3** nearer to the opening than the home position in the state **1**, so that visibility of the sheet ejected on the sheet ejection tray can be improved and the sheet can be removed without any difficulty.

Additional modifications and variations of the present invention are possible in light of the above teachings. It is therefore to be understood that, within the scope of the appended claims, the invention may be practiced other than as specifically described herein.

What is claimed is:

1. An image forming apparatus, comprising:

an apparatus body including at least one side, the at least one side of the image forming apparatus is an open side;

an image forming device configured to form an image on a sheet member;

a sheet ejection container including a sheet ejection tray, a first opening and a second opening, the first opening being downstream in a sheet member ejection direction, the second opening being downstream in a moving direction of the sheet ejection tray, the first opening configured to (i) eject the sheet member from an inside of the image forming apparatus to the sheet ejection tray, the sheet ejection container being inside the apparatus body at the open side of the image forming apparatus, the sheet ejection tray configured to,

stack the sheet member ejected from the apparatus body, and

move between a first position and a second position in the sheet ejection container, the first position corresponding to the sheet member being ejected to the sheet ejection tray and the sheet ejection tray being opposite and away from the open side of the image forming apparatus, the second position corresponding to the sheet ejection tray being adjacent to the open side of the image forming apparatus, the moving direction of the sheet ejection tray towards the second opening corresponds to movement from the first position to the second position in a direction perpendicular to the sheet member ejection direction;

cover members including a first cover and a second cover, the cover members configured to cover at least one opening of the sheet ejection container, the first cover configured to (i) open and close the opening downstream in the sheet member ejection direction of the sheet ejection container, and (ii) open when the length of the sheet member in a sheet member conveyance direction is longer than the width of the sheet ejection tray in the sheet member ejection direction, the second cover configured to (i) open and close the opening disposed in the moving direction of the sheet ejection tray, and (ii) open when the length of the sheet member in the sheet member conveyance direction is shorter than the width of the sheet ejection tray in the sheet member ejection direction; and

an assembly in the apparatus body, the assembly configured to open and close the cover members.

2. The image forming apparatus of claim **1**, further including, a sheet ejection tray driver connected to the sheet ejection tray, the sheet ejection tray driver configured to move the sheet ejection tray between the first position and the second position.

3. The image forming apparatus of claim **1**, further including,

an end fence on the sheet ejection tray, the end face is perpendicular to the sheet member conveyance direction, the end face configured to (i) move in a sheet member conveyance perpendicular direction, and (ii) contact and stop one end of the sheet member placed on a sheet stacking surface, the sheet member conveyance perpendicular direction corresponds to conveying of the sheet member to the sheet stacking surface of the sheet ejection tray.

4. The image forming apparatus of claim **1**, further including,

a sheet ejection tray driver connected to the sheet ejection tray, the sheet ejection tray driver configured to open and close the first cover and the second cover.

5. The image forming apparatus of claim **4**, further including,

a switch in front of the apparatus body adjacent to the second cover, the switch configured to open and close the cover members via the sheet ejection tray driver.

6. The image forming apparatus of claim **5**, further including,

a light-emitting diode in an interior of the switch, the light-emitting diode configured to illuminate the switch.

7. The image forming apparatus of claim **1**, wherein the second position of the sheet ejection tray corresponds to movement of the sheet ejection tray in a direction parallel to the sheet member ejection direction.

8. The image forming apparatus of claim **1**, wherein the second position of the sheet ejection tray corresponds to movement of the sheet ejection tray in a direction perpendicular to the sheet member ejection direction.

9. An image forming apparatus, comprising:

a sheet ejection container including a first opening, a second opening and a sheet ejection tray, the sheet ejection tray configured to (i) move between a first position and a second position, and (ii) stack at least one sheet member, the first opening is downstream in a sheet member ejection direction, the second opening is downstream in a sheet member conveyance direction;

an assembly configured to open and close cover members, the cover members including a first cover and a second cover, the first cover configured to (i) open and close the first opening of the sheet ejection container, and (ii) open when length of the sheet member in the sheet member conveyance direction is longer than the width of the sheet ejection tray in the sheet member ejection direction, the second cover configured to (i) open and close the second opening of the sheet ejection container, and (ii) open when the length of the sheet member in the sheet member conveyance direction is shorter than the width of the sheet ejection tray in the sheet member ejection direction;

a sheet ejection tray driver connected to the sheet ejection tray, the sheet ejection tray driver configured to move the sheet ejection tray between the first position and the second position; and

a switch in front of an apparatus body adjacent to the second cover, the switch configured to open and close the cover members via the sheet ejection tray driver.

10. The image forming apparatus of claim **9**, wherein the second position of the sheet ejection tray corresponds to movement of the sheet ejection tray in a direction parallel to the sheet member ejection direction.

11. The image forming apparatus of claim **1**, wherein the second position of the sheet ejection tray corresponds to movement of the sheet ejection tray in a direction perpendicular to the sheet member ejection direction.

12. A method of forming an image, comprising:

providing an image forming apparatus, the image forming apparatus includes,

a sheet ejection container including a first opening, a second opening and a sheet ejection tray, the sheet ejection tray configured to (i) move between a first position and a second position and (ii) stack at least one sheet member, the first opening is downstream in a sheet member ejection direction, the second opening is downstream in a sheet member conveyance direction;

an assembly configured to open and close cover members, the cover members including a first cover and a second cover, the first cover configured to (i) open and close the first opening of the sheet ejection container, and (ii) open when length of the sheet member in the sheet member conveyance direction is longer than the width of the sheet ejection tray in the sheet member ejection direction, the second cover configured to (i) open and close the second opening of the sheet ejection container, and (ii) open when the length of the sheet member in the sheet member conveyance direction is shorter than the width of the sheet ejection tray in the sheet member ejection direction;

a sheet ejection tray driver connected to the sheet ejection tray, the sheet ejection tray driver configured to move the sheet ejection tray between the first position and the second position; and

a switch in front of an apparatus body adjacent to the second cover, the switch configured to open and close the cover members via the sheet ejection tray driver.

13. The method of claim **12**, wherein the second position of the sheet ejection tray corresponds to movement of the sheet ejection tray in a direction parallel to the sheet member ejection direction.

14. The method of claim **12**, wherein the second position of the sheet ejection tray corresponds to movement of the sheet ejection tray in a direction perpendicular to the sheet member ejection direction.

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